

EXEMPLIFYING THE BRADFORD'S LAW: AN ANALYSIS OF RECENT RESEARCH (2014-2019) ON CAPITAL STRUCTURE

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ABSTRACT

The theme of capital structure is considered relevant within Corporate Finance because it refers to decisions that influence the way companies finance themselves, impacting the value and financial commitment of organizations. The main objective of this article is to analyze the recent world academic production (2014-2019) on capital structure through the use of the Bradford Law. For this, we collected the scientific articles available in the Web of Science. Data analysis was done through the description and use of the Bradford Act. The main results indicated that the peak of scientific production on the subject occurred in 2017 (1,765 articles). It was identified that two authors stand out as the most prolific in the theme. The application of the Bradford Act indicated that there is concentration of production in 5% of the journals (taken as 'Core' of the publication on capital structure) which concentrates 2387 works. The magazines considered "Important" correspond to 19% (531 of them), publishing 2,262 articles. The other magazines are considered "Noise" since they have published two or one articles. Because it is a relevant subject both in the business and academic aspects, as well as the fact that there are still gaps in the literature, new research is still expected, which makes it necessary to investigate how research is behaving.

Keywords: Bradford's Law; Bibliometria; Capital structure.

EXEMPLIFICANDO A LEI DE BRADFORD: ANÁLISE DAS RECENTES PUBLICAÇÕES (2014-2019) SOBRE ESTRUTURA DE CAPITAL

RESUMO

O tema da estrutura de capital é considerado relevante dentro das Finanças Corporativa, porque se refere às decisões que influenciam a forma como as empresas se financiam, impactando o valor e o comprometimento financeiro das organizações. O objetivo principal deste artigo é analisar a recente produção acadêmica mundial (2014-2019) sobre estrutura de capital por meio do uso da Lei de Bradford. Para isso, coletou-se os artigos científicos disponíveis na Web of Science. A análise dos dados foi feita através da descrição e do uso da Lei de Bradford. Os principais resultados indicaram que o pico de produção científica sobre o assunto ocorreu em 2017 (1.765 artigos). Identificou-se que dois autores se destacam como os mais prolíficos no tema. A aplicação da Lei de Bradford indicou que há concentração de produção em 5% dos periódicos (tomado como 'Núcleo' da publicação sobre estrutura de capital) que concentra 2387 trabalhos. As revistas consideradas "Importantes" correspondem a 19% (531 delas), publicando 2.262 artigos. As outras revistas são consideradas "Ruído", uma vez que publicaram dois ou um artigo. Por ser um tema relevante tanto no aspecto empresarial quanto no acadêmico, bem como o fato de ainda existirem lacunas na literatura,

novas pesquisas ainda são esperadas, o que torna necessário investigar como a pesquisa está se comportando.

Palavras-chave: Lei de Bradford; Bibliometria; Estrutura de capital

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1 Introduction

Capital structure is highlighted within Corporate Finance because if the issue refers to the decisions related to the sources financed from the investment projects of the entities, they have repercussions on the value of the company and the financial commitment of the entity. There is a maturation of scientific production on the subject (which has led to the development of a vast volume of scientific productions and theories) (MODIGLIANI; MILLER, 1958, 1963; MYERS, 1984; SHYAM-SUNDER; MYERS, 1999; BAKER; WURGLER, 2002, 2007; TSUJI, 2011; BUETTNER et al., 2012; LIMA et al., 2012; CORREA; BASSO; NAKAMURA, 2013; PADILHA; SILVA, 2016).

Despite this volume of research, few studies are analyzing the characteristics of this production, especially the question of the concentration of this production. Thus, this research intends to contribute to the theme by employing the Bradford's Law to verify the concentration of production on capital structure in journals.

Therefore, this paper intends to answer the following research question: **Is there a concentration of scientific production on capital structure in some journals?** To do so, the following general objective was defined: to analyze the recent (2014-2019) world academic production on capital structure through the use of the Bradford Law.

A bibliometric study was developed with 7,272 articles on the subject resulting from the search in the Web of Science database. Being analyzed the production on the thematic in the aspect of the authors of this production, the temporal cut and the verification of the concentration of scientific production through the Bradford Law.

This article is divided into five sections. The first of these corresponds to this introduction. In the second section we present the theoretical reference guide of the research. The third section is dedicated to the presentation of the methodological aspects of the research. In section four, the main results of the research are presented and discussed. The conclusions of the study are summarized in the last section.

2 Theoretical review

2.1 Bradford Law's

Analyzing the attributes of scientific production by means of mathematical or statistical instruments is the objective of bibliometry (PRITCHARD, 1969). Bibliometrics is the tool that enables the creation and mapping of indicators for the treatment and administration of information, as well as the analysis of the means of scientific dissemination and of the productivity of a given community and scientific network (CHUEKE; AMATUCCI, 2015).

The term 'bibliometry' was created by Paul Otlet in 1934. It was later identified as 'scientific bibliography' (a term termed by Hulme in 1923). But the popularization of the term 'bibliometry' occurred with Pritchard (1969). The need to evaluate and study production and scientific communities was what drove the creation and development of bibliometrics. In the field of bibliometrics, three Laws were highlighted: Lotka's Law, Zipf's Law and Bradford's Law (FERREIRA, 2010).

Lotka's Law (or Law of Inverse Square) indicates that there is a quantitative relationship between the frequency of authors producing a number x of works. Few authors concentrate the largest share of scientific production, and a larger group of authors produce fewer articles. The number of authors who make 'n' contributions is equal to $\frac{1}{n^2}$ of those who made a contribution (GARCIA et al., 2016; QUEVEDO-SILVA et al., 2016; MELLO et al., 2017).

Zipf's Law, or Law of Minor Effort, points out that researchers have a preference for using a few words (especially shorter words and acronyms) than in other words. A small group of words is more recurring in the articles than the other words within the publication (FERREIRA, 2010; GARCIA et al., 2016; QUEVEDO-SILVA et al., 2016).

The Bradford's Law (known as Productivity or Periodic Dispersion) analyzes the productivity of journals. According to this Law, few journals concentrate relevant articles in a particular area, and many journals have few articles on a given area. It makes it possible to determine the most relevant journals for a topic. The journals could be classified into three groups: the first would contain 33% of the production, composed of highly productive (essential) journals; the latter by the next 33%, composed of a larger group with less productive (important) journals and the last group would contain a much larger group of journals that have a lower contribution (noise) (FERREIRA, 2010; GARCIA et al., 2016; QUEVEDO-SILVA et al., 2016).

2.1 Capital Estructure

The capital structure deals with how organizations combine equity and third-party resources, so as to optimize the use of sources of finance (SCHROEDER; CLARK; CATHEY, 2005). As a result of the range of research developed in these fields, theories have been proposed that seek to explain decisions about capital structure: such as the irrelevance of Modigliani and Miller's capital structure, Trade-off theory, Pecking Order theory, Market Timing.

Modigliani e Miller (1958) concluded that the capital structure is irrelevant to the firm's value, given the existence of a perfect market (with no information asymmetry, no taxation and other theoretical assumptions). This argument bases the theory of the irrelevance of the capital structure. Subsequently, the authors themselves found some relevance to the capital structure if we consider the influence of taxes on the market (MODIGLIANI; MILLER, 1963).

For the Pecking Order theory, companies adjust their capital structure according to a hierarchy of funding sources. This hierarchy is influenced by two issues: financial cost and informational level. Initially, the company will finance itself with funds generated internally (it has lower financial and informational costs, since the resource already belongs to the company), when these are not sufficient to finance the investment projects, the company will resort to debt (the firm is already and when the debt is not sufficient, then it will issue shares (the company is already spending more informational cost to the market) (MYERS, 1984;

SHYAM-SUNDER; MYERS, 1999; COTEI; FARHAT; ABUGRI, 2011; MANTEZELLI et al., 2017; HENRIQUE et al., 2018).

Another theory is the Trade-off, according to which companies seek to reach an optimal point between equity and third-party capital, rather than following a hierarchy of financing preference. According to this theory, the company would prefer indebtedness (since interest paid on debt could be written off in corporate income tax, benefit from indebtedness) to the point where the cost and risk of new indebtedness would outweigh the benefit of indebtedness (MYERS, 1984; TSUJI, 2011; BUETTNER et al., 2012; LIMA et al., 2012; CORREA; BASSO; NAKAMURA, 2013).

In turn, the Market Timing theory works with the idea of windows of opportunity. According to this proposition, the company will issue shares when it considers that the price is above its real value (overvalued shares) and will repurchase them when they are undervalued (BAKER; WURGLER, 2002, 2007; PADILHA; SILVA, 2016).

3 Research methods

3.1 Search Characterization

Regarding the objective, this research is descriptive. Descriptive studies aim to describe or register characteristics of a phenomenon, without interfering with it (PRODANOV; FREITAS, 2013). This study aims to exemplify the Bradford Law on the recent (2014-2018) research on capital structure in Brazilian journals, describing this scientific production and verifying whether or not there is concentration of scientific production.

In the case of the problem, this study is of the qualitative-quantitative type. Quantitative research is marked by the use of statistical techniques (from more basic techniques such as descriptive statistics, to more robust techniques such as regression models), in turn, qualitative research is recognized for performing readings and interpretations of social realities. The combination of these two types of research has the advantage of broadening the view on the problem investigated, allowing a deeper analysis (SOUZA; KERBAUY, 2017). For the analysis of Brazilian production on capital structure, this research uses descriptive statistics to quantify this production and also uses a description of the qualitative aspects.

3.2 Characterization of the analysis

3.2.1 Data collection

The data were collected in the Web of Science database, and the collection was performed on December 14, 2018. Scientific articles on the term 'capital structure' published in the last five years (2014-2019) were searched. Note that they will be published in 2019 are already available in the database (since they have already been approved in their journals of origin).

3.2.2 Sample

Of the total of 8,985 results presented for the searches in the database, an intentional non-probabilistic sample of 7,272 scientific articles was obtained (excluding those materials that were not scientific articles).

3.2.3 Analyze

The data of the articles were tabulated in the software Excel 2010. After the tabulation, the analyzes took place through counts, means of the frequencies of the information and the application of the Bradford's Law.

For Bradford's Law, the manual methodology (presented and exemplified in section 4) was followed. So a chart of lines was drawn to see if the dispersion of results follows the behavior expected by the Bradford's Law. In the following section the results of the research are presented, besides presenting a discussion of them.

4 Findings and discussion

The research returned a total of 7,272 scientific articles published in the last five years (2014-2019) available in the Web of Science. It should be emphasized that this is an intentional non-probabilistic sampling, therefore, the results can not be generalized for all scientific production on capital structure.

The sample articles were written by 16,283 researchers. The authors of the most prominent are the Yang Zhaojun (13 articles) and Huan Zhang (13 articles). Together, these two authors are present in 0.14% of the work authors in the sample. The majority of the authors came from the United States (1,771 or 18% of the authors declared themselves to be from this region), China (794 or 8%) and England (771 or 8%).

The year in which there were more publications was 2017 (1,765 or 24.27% of the article sample). It should be noted that the year 2018 had not yet closed when this collection was carried out, perhaps new articles (in addition to 1,592 or 21.82%) could still be published in the days that will continue until the end of the year. As well as the year 2019 (with 20 articles or 0.27%) that although articles are already available, has not yet started this year until the date of the collection of the articles.

After the sample was known in its descriptive aspect, the application of the Bradford's Law to this sample was verified. To check whether some journals are concentrating scientific production on a topic, Bradford's Law can be used through a manual and algebraic version.

In the manual version, the data are arranged in a table so that one column has the name of the journal and another with the number of articles published by it. This table should be in descending order in relation to the number of articles published by the journal.

Then a summary table is drawn up, in which in the first column (called column A) the number of journals with " n " publications is placed; in the second table (Column B) is put the contributions that the journals have, the " n ". For example, if there is a journal with 27 articles and 3 journals with 15 articles, column A will be filled with numbers 1 and 3 (number of journals with " n " publications) and column B will contain the numbers 27 and 15 (" n " Publications). After that, a third column (column C) will be filled in, which will contain the accumulated value of the frequencies of Column A. Then the Ln of column C (the column Ln is created) and the column D (which shows the cumulative total of frequencies in column B). Finally, the column E (which results from the multiplication of columns A and B) is calculated. From the columns Ln and D, a scatter plot is drawn which, if closer to the "S" shape, is more concentrated in academic journals.

The journals that concentrate the first $\left(\frac{1}{3}\right)$ of scientific production represent the 'core' of concentration; those of the second $\left(\frac{1}{3}\right)$ represent the 'important' journals, and the other periodicals are the 'noise'. Manually it is necessary to divide the total articles by the total of

zones (in our case, we are adopting three zones, $\frac{1}{3}$) to obtain the number of articles per zone. Since the journals are already in decreasing order, the first journals will be selected until the quota of articles by zone is reached, then the same procedure is done for the other journals until reaching the quota by zone, and then the others are selected. Once the zones have been defined, it must be verified that they follow the 1:n:n². The total journals of the second zone are divided by the total of the first zone and the one of the first zone has to be divided by the nucleus if the two divisions result in close numbers, that number is the Bradford multiplier, otherwise it should be divided in more areas than the initial quantity (RIBEIRO, 1983; EGGHE; ROUSSEAU, 1990; COUTINHO, 1991; RIBEIRO; CHALHUB; NISENBAUM, 2016).

In the algebraic (or analytical) method it is possible, through formulas, the Bradford multiplier and the zones directly (RIBEIRO, 1983; EGGHE; ROUSSEAU, 1990; COUTINHO, 1991; RIBEIRO; CHALHUB; NISENBAUM, 2016). To calculate the Bradford multiplier, we follow Equation 1.

$$k = (1.781 * Ym)^{\frac{1}{P}} \quad \text{Equation 1}$$

Where Ym refers to the maximum productivity (1st column value D of the manual method). P = number of zones to be worked on (three zones are usually used). The k will be the Bradford multiplier. To find out how many journals will be in the nucleus, see Equation 2.

$$r_0 = \frac{T*(k-1)}{(k^P-1)} \quad \text{Equation 2}$$

Where r_0 represents the number of journals that will make up the nucleus. T refers to the total journals of the sample collected (in this case, it would be the last value of column C). The k is the Bradford multiplier and P is the number of zones that one wants to work. In order to find the number of journals for Zone 1 one must multiply r_0 by k . For Zone 2, multiply r_0 by k^2 . If there is a Zone 3, then multiply r_0 by k^3 , and so on, for both k_i for how many i Zones there are. He applied the Bradford's Law for the analyzed sample, drawing Graph 1.

Graph 1: Application of Bradford's law in the sample

Source: Prepared by the authors

The recent scientific output on capital structure follows the expected behavior for the Bradford's Law ('S' format). This indicates that, in fact, there are journals that concentrate the majority of the research, being, therefore, the journal that is dedicated more to divulge the thematic one.

Manually the segregation of the sample was tested in three zones (Core, Zone 1 and Zone 2). The research resulted in 2,828 journals that published on the subject, totaling 7,300 papers (possibly some articles were published duplicatively in some journals, so that number is larger than the number of different articles in the sample). When dividing the 7,300 works in three zones, it was discovered that each zone should contain 2433 articles.

When the articles were distributed between the zones (until the accumulated total of articles of the journals arrived as close as possible to 2433), different values were obtained between each zone. The Core (essential journals) was composed of 134 journals (5% of journals) that published from 9 to 128 articles, concentrating 2387 articles. Zone 1 (important journals) consists of 531 journals (19%) that published 8 to 3 articles, concentrating 2,262 searches. Zone 2 (noise) is formed by 2.163 journals (76%) that published two or one articles, concentrating 2,651 articles.

In relation to the Bradford multiplier, this was close to 4. When dividing the total of journals of Zone 2 by Zone 1 was obtained the value 4.1. When dividing the total of journals of Zone 1 by the Core obtained 3.96. Therefore, the Bradford multiplier is approximately 4. If the number of zones increases, the Bradford multiplier will tend to decrease and the total of articles by zones may be closer.

Although the number of articles belonging to the Nucleus is in the hundreds, it is worth mentioning that this total is equivalent to only 5% of the total journals. In addition, we are talking about all the magazines in the world, available in the Web of Science, which published at least an article on the subject.

5 Conclusion

This paper sets out to analyze the recent (2014-2019) world academic production on capital structure through the use of the Bradford Act. A bibliometric study of this participation was carried out in 7,272 scientific articles, written by 16,283 different authors, being published by 2,828 journals between 2014 and 2019.

The objective of the study was reached, since the findings of the research make it possible to investigate the production on capital structure. The main findings indicated that academic production on the subject during the analyzed period peaked in 2017 (1,765 articles). In addition, it was identified that two authors stand out as they participated in more articles in the subject: Zhaojun Yang and Huan Zhang, both with 13 articles published in the sample.

The application of the Bradford's Law indicated that there is concentration of production in some journal (taken as the 'core' of the publication on capital structure). He identified that 5% of journals (134 of them), $\frac{1}{3}$ of the works (2387), these journals being regarded as the 'essentials'. The second $\frac{1}{3}$ of the sample was concentrated in 19% of the journals (531 of them), publishing 2,262 articles, considered as important journals. Finally, there are articles that eventually publish on the subject (considered as 'noise'), which represent 76 of the 2,828 (that is, 2,163 journals), together they concentrate 2,651 articles.

The 'essential' journals are considered the main channels of scientific dissemination on a theme. They, in addition to being very prestigious by researchers, are also considered as specialized by the scientific community. Identifying this type of journal enables researchers to obtain more relevant and current bibliographic references as well as makes it easier for scientists to decide where they can publish their research.

As a suggestion for future work, it is indicated the enlargement of the sample considering articles that may be available only in other databases. Another possibility would be the inclusion of other materials for the publication of scientific results, as well as articles from periodicals, such as papers published at events and course completion work. As the sample is expanded to other modes of publication of scientific papers, it is advisable to use more robust statistical techniques, such as regression models.

The theme of capital structure is considered relevant within Corporate Finance, since it implies decisions that influence the form of financing of firms, affecting the value and financial commitment of the organization. Despite the volume of publication, the theme is still current and relevant, given the emergence of new forms of the organizations to be financed, as well as the gaps that still persist in the academic literature. New research needs to be developed in order to verify the dynamics of research on capital structure.

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